UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/508,960	10/06/2004	Danny S Moshe	28559	7541

7590 01/29/2007

Martin Moynihan
Anthony Castorina
Suite 207
2001 Jefferson Davis Highway
Arlington, VA 22202

EXAMINER	
TURNER, SAMUEL A	
ART UNIT	PAPER NUMBER
2877	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/29/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/508,960	Applicant(s) MOSHE, DANNY S
	Examiner Samuel A. Turner	Art Unit 2877

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 October 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *3-111* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *3-111* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/25/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 25 October 2005 has been considered by the examiner.

Abstract

The abstract of the disclosure is objected to because the abstract must be limited to a single paragraph on a separate sheet. Correction is required. See MPEP § 608.01(b).

Claim Rejections - 35 USC § 112, first paragraph

The following is a quotation of the first paragraph of 35 U.S.C. § 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3-111 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

With regard to claims 1, 38, 56, and 86; the phrase "piezoelectrically determining and changing magnitude of said optical path difference" does not meet the enablement requirement. The piezoelectric motor for driving the scanning

mirror is fully disclosed which provides enablement for "piezoelectrically changing magnitude of said optical path difference". There is not enablement for "piezoelectrically determining the magnitude of said optical path difference". The only means for determining the optical path difference for which enablement is found is a capacitive sensor.

Claim Rejections - 35 USC § 101

35 U.S.C. § 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 23-27, and 29-37 are rejected under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter.

The claims are directed to a judicial exception; as such, pursuant to the Interim Guidelines on Patent Eligible Subject Matter (MPEP 2106)), the claims must have either physical transformation and/or a useful, concrete and tangible result. The claims fail to include transformation from one physical state to another. Although, the claims appear useful and concrete, there does not appear to be a tangible result claimed. Merely analyzing, calculating, determining, selecting, etc. would not appear to be sufficient to constitute a tangible result, since the outcome of the analyzing, calculating, determining, selecting, etc. step has not been used in a disclosed practical application nor made available in such a manner that its

usefulness in a disclosed practical application can be realized. As such, the subject matter of the claims is considered an abstract idea and is not patent eligible.

Claim 23 is directed to the step of "improving quality of said plurality of recorded interference images". Claims 24-27 further limit claim 23 with limitations directed to "filtering out noise from said plurality of recorded interference images", claim 24; "correcting distortions", claim 25; "correcting dynamic imaging errors", claim 26; and "improving resolution of said plurality of recorded interference images", claim 27. These limitations do not provide a physical transformation and/or a useful, concrete and tangible result. While these steps appear useful and concrete the analyzed, calculated, determined, selected, etc result is abstract because nothing is done with the result(saved, displayed, or used).

Claim 29 is directed to the step of "transforming each of said plurality of improved quality interference images from time domain to frequency domain". Claims 30-37 directly of indirectly further limit claim 29 with limitations directed to "using a Fast-Fourier-Transform procedure", claim 30; "synthesizing and analyzing three-dimensional hyper-spectral cube images", claim 31; "improving quality of each of said plurality of interferogram images", claim 32; "wherein said plurality of interferogram images is deconvolutioned", claims 33 and 34; "correcting phase of pixels in each of said plurality of improved quality interferogram images", claim 35; "transforming each of said plurality of phase corrected improved quality interferogram images", claim 36; and "analyzing a plurality of said synthesized

hyper-spectral cube images", claim 37. These limitations do not provide a physical transformation and/or a useful, concrete and tangible result. While these steps appear useful and concrete the analyzed, calculated, determined, selected, etc result is abstract because nothing is done with the result(saved, displayed, or used).

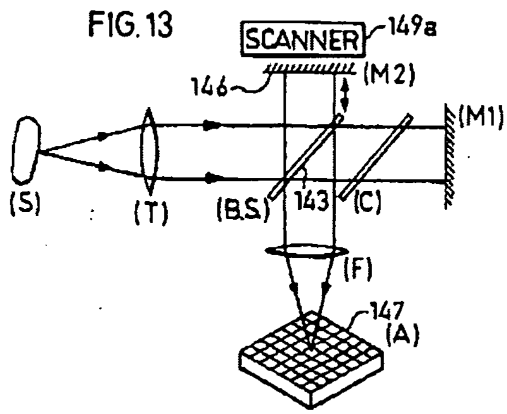
Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3-8, 11, 21, 22, 38-43, 46, 56-60, 63, 73, 86, 87, and 90 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Cabib et al(5,539,517) in view of Tsuda(6,697,160).

FIG. 13



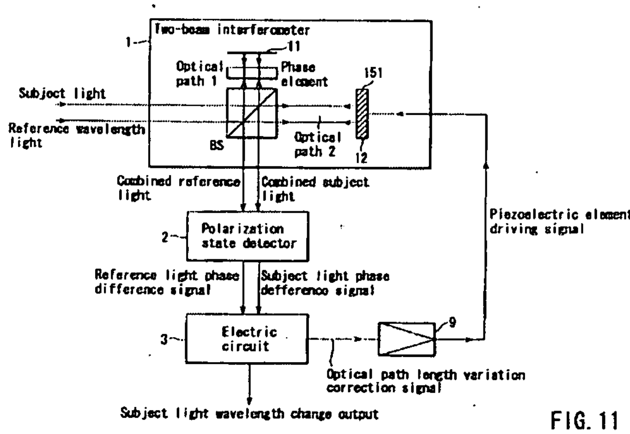


FIG. 11

With regard to claim 3, Cabib et al teach a method for real time hyper-spectral imaging(**column 15, lines 34-44**), comprising the steps of:

(a) emitting electromagnetic radiation in a form of an object emission beam, by objects in a scene or a sample, and collimating said object emission beam, using an electromagnetic radiation collimating element, for forming a collimated object emission beam(**Fig. 13, S; column 5, lines 1-10**);

(b) receiving and dividing said collimated object emission beam by an optical interferometer, for forming a divided collimated object emission beam having an optical path difference, and for generating an interference image exiting said optical interferometer(**Fig. 13, column 15, lines 34-44**), wherein said optical interferometer includes:

(i) a beam splitter, onto which said collimated object emission beam is incident, and by which said collimated object emission beam is divided into two beams(**Fig. 13, 143**),

(ii) a fixed mirror operatively positioned relative to said beam splitter(**Fig. 13, M1**),

(iii) a movable mirror operatively positioned relative to said fixed mirror and to said beam splitter, and wherein said fixed mirror and said movable mirror each receives and reflects one of said two beams, such that a difference exists in lengths of optical path traveled by said two beams exiting

said optical interferometer, thereby forming said optical path difference(**Fig. 13, M2**),

(iv) a piezoelectric motor, operatively connected to said movable mirror(**Fig. 13, 149a; column 5, lines 64-65**),

piezoelectric motor and to said distance change feedback sensor, and

(vii) an optical interferometer mount, as a mount of said beam splitter, said fixed mirror, said movable mirror, and said piezoelectric motor(**Fig. 13, inherent; some mount or housing must support the elements**); and

(d) focusing and recording each said generated interference image associated with a corresponding said magnitude of said optical path difference, for forming a plurality of recorded interference images(**Fig. 13; F,147; column 15, lines 34-44**).

Cabib et al **fail to teach** a distance change feedback sensor or a piezoelectric motor controller, therefor there is no feedback control for the piezoelectric motor including the steps of displacing said movable mirror, sensing and measuring change in distance of said movable mirror, and actuating and controlling said piezoelectric motor by said piezoelectric motor controller.

As to claim 21, wherein step (d) each said interference image is focused by camera optics(**Fig. 13, F**).

As to claim 22, wherein electromagnetic radiation within a particular spectral region of interest of each said interference image exiting said optical

interferometer is additionally focused by an electromagnetic radiation filter placed before said camera optics(**column 12, lines 8-29**).

With regard to claim 38, Cabib et al teach a method for real time dividing a collimated object emission beam of electromagnetic radiation emitted by objects in a scene or a sample(**Fig. 13, column 15, lines 34-44**), comprising the steps of:

(a) receiving and dividing the collimated object emission beam by the optical interferometer, for forming the divided collimated object emission beam having the optical path difference(**Fig. 13, 143; column 15, lines 34-44**), wherein the optical interferometer includes:

(i) a beam splitter, onto which the collimated object emission beam is incident, and by which the collimated object emission beam is divided into two beams(**Fig. 13, 143**),

(ii) a fixed mirror operatively positioned relative to said beam splitter(**Fig. 13, M1**),

(iii) a movable mirror operatively positioned relative to said fixed mirror and to said beam splitter, and wherein said fixed mirror and said movable mirror each receives and reflects one of said two beams, such that a difference exists in lengths of optical path traveled by said two beams exiting the optical interferometer, thereby forming the optical path difference(**Fig. 13, M2**),

(iv) a piezoelectric motor, operatively connected to said movable mirror(**Fig. 13, 149a; column 5, lines 64-65**),

(vii) an optical interferometer mount, as a mount of said beam splitter, said fixed mirror, said movable mirror, and said piezoelectric motor(**Fig. 13, inherent; some mount or housing must support the elements**); and

(b) displacing said movable mirror along an axis of the divided collimated object emission beam by said piezoelectric motor(**Fig. 13; column 15, lines 34-44**).

Cabib et al **fail to teach** a distance change feedback sensor or a piezoelectric motor controller, therefor there is no feedback control for the piezoelectric motor including the steps of displacing said movable mirror, sensing and measuring change in distance of said movable mirror, and actuating and controlling said piezoelectric motor by said piezoelectric motor controller.

With regard to claim 56, Cabib et al teach a system for real time hyper-spectral imaging(**Fig. 13**), comprising:

(a) an electromagnetic radiation collimating element, for collimating electromagnetic radiation emitted by objects in a scene or a sample, for forming a collimated object emission beam(**Fig. 13, T**);

(b) an optical interferometer, for receiving and dividing said collimated object emission beam, for forming a divided collimated object emission beam having an optical path difference, and for generating an interference image exiting said optical interferometer, said optical interferometer includes(**Fig. 13**):

(i) a beam splitter, onto which said collimated object emission beam is incident, and by which said collimated object emission beam is divided into two beams(Fig. 13, 143),

(ii) a fixed mirror operatively positioned relative to said beam splitter(Fig. 13, M1),

(iii) a movable mirror operatively positioned relative to said fixed mirror and to said beam splitter, and wherein said fixed mirror and said movable mirror each receives and reflects one of said two beams, such that a difference exists in lengths of optical path traveled by said two beams exiting said optical interferometer, thereby forming said optical path difference(Fig. 13, M2),

(iv) a piezoelectric motor, operatively connected to said movable mirror(Fig. 13, 149a; column 5, lines 64-65),

(v) a distance change feedback sensor, operatively connected to said movable mirror,

(vi) a piezoelectric motor controller, operatively connected to said piezoelectric motor and to said distance change feedback sensor, and

(vii) an optical interferometer mount, as a mount of said beam splitter, said fixed mirror, said movable mirror, and said piezoelectric motor(Fig. 13, inherent; some mount or housing must support the elements);

(c) camera optics, for focusing each said generated interference image associated with a corresponding said magnitude of optical path difference(**Fig. 13, F**); and

(d) a detector, for recording each said generated interference image, for forming a plurality of recorded interference images(**Fig. 13, 147**).

Cabib et al **fail to teach** a distance change feedback sensor or a piezoelectric motor controller, therefor there is no feedback control for the piezoelectric motor including the steps of displacing said movable mirror, sensing and measuring change in distance of said movable mirror, and actuating and controlling said piezoelectric motor by said piezoelectric motor controller.

As to claim 73, wherein an electromagnetic radiation filter is placed before said camera optics, for additionally focusing electromagnetic radiation within a particular spectral region of interest of each said interference image exiting said optical interferometer (**column 12, lines 8-29**).

With regard to claim 86, Cabib et al teach an optical interferometer for real time dividing a collimated object emission beam of electromagnetic radiation emitted by objects in a scene or a sample(**Fig. 13**), comprising:

(a) a beam splitter, onto which the collimated object emission beam is incident, and by which the collimated object emission beam is divided into two beams(**Fig. 13, 143**);

(b) a fixed mirror operatively positioned relative to said beam splitter(**Fig. 13, M1**);

(c) a movable mirror operatively positioned relative to said fixed mirror and to said beam splitter, and wherein said fixed mirror and said movable mirror each receives and reflects one of said two beams, such that a difference exists in lengths of optical path traveled by said two beams exiting the optical interferometer, thereby forming the optical path difference(**Fig. 13, M2**);

(d) a piezoelectric motor, operatively connected to said movable mirror, for displacing said movable mirror along an axis of the divided collimated object emission beam(**Fig. 13, 149a; column 5, lines 64-65**); and

(g) an optical interferometer mount, as a mount of said beam splitter, said fixed mirror, said movable mirror, said piezoelectric motor, and said distance change feedback sensor(**Fig. 13, inherent; some mount or housing must support the elements**).

Cabib et al **fail to teach** a distance change feedback sensor or a piezoelectric motor controller, therefor there is no feedback control for the piezoelectric motor including the steps of displacing said movable mirror, sensing and measuring change in distance of said movable mirror, and actuating and controlling said piezoelectric motor by said piezoelectric motor controller.

As to claims 4, 39, and 57; wherein said objects inherently emit said electromagnetic radiation of said object emission beam as a result of inherent body thermal heat emitted by said objects(**Fig. 13, S; column 5, lines 1-10**).

As to claims 5, 40, and 58; wherein said objects emit said electromagnetic radiation of said object emission beam as a result of excitation by incident electromagnetic radiation supplied by an external source radiating said incident electromagnetic radiation upon said objects(**Fig. 13, S; column 5, lines 1-10**).

As to claims 6, 41, and 59; wherein said incident electromagnetic radiation is in a form of light selected from the group consisting of polychromatic light, monochromatic light, poly- or multi-monochromatic light, and, combinations thereof(**Fig. 13, S; column 5, lines 1-10**).

As to claims 7 and 42, including the steps of:

(i) passing a first part of said collimated object emission beam through said beam splitter and onto said fixed mirror, while reflecting a second part of said collimated beam off said beam splitter and onto said movable mirror(**Fig. 13**), and

(ii) reflecting said first part of said collimated object emission beam off said fixed mirror, onto and off said beam splitter, for forming a first exiting beam exiting said optical interferometer, while reflecting and passing said second part of said collimated object emission beam off said movable mirror and through said beam splitter, respectively, for forming a second exiting beam exiting said optical

interferometer together with said first exiting beam, thereby generating said interference image(Fig. 13).

As to claims 8 and 43, Cabib et al **fail to teach** including the steps of:

(i) passing a first part of said collimated object emission beam through said beam splitter and onto said movable mirror, while reflecting a second part of said collimated beam off said beam splitter and onto said fixed mirror, and

(ii) reflecting said first part of said collimated object emission beam off said movable mirror, onto and off said beam splitter, for forming a first exiting beam exiting said optical interferometer, while reflecting and passing said second part of said collimated object emission beam off said fixed mirror and through said beam splitter, respectively, for forming a second exiting beam exiting said optical interferometer together with said first exiting beam, thereby generating said interference image.

As to claims 11, 46, 63, and 90; Cabib et al **fail to teach** wherein said piezoelectric motor controller operates as a closed loop controller of said change in distance of said movable mirror along said axis.

As to claims 60 and 87, wherein said beam splitter is selected from the group consisting of a rectangular shaped beam splitter and a cubic shaped beam splitter(Fig. 13, 143).

Tsuda teaches a Michelson interferometer(Fig. 11) comprising a beam-splitter(Fig. 11, BS), fixed mirror(Fig. 11, 11), a movable mirror(Fig. 11, 12) driven

by a piezoelectric motor(**Fig. 11, 151**), a path length displacement sensor operatively connected to the movable mirror (**Fig. 13, the reference light**), and a piezoelectric motor controller(**Fig. 11; 3,9**). The resulting feedback control loop provides an optical path length variation correction to the driver(**Fig. 11, 9; column 17, lines 9-36**).

With regard to claims 3, 11, 38, 46, 56, 63, 86, and 90; it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cabib et al by adding the a path length displacement sensor and piezoelectric motor controller, of Tsuda, to control the piezoelectric motor 149a.

The motivation for this modification is found in Tsuda which corrects any optical path length variations of the piezoelectric motor. Claims 4-8, 21, 22, 39-43, 57-60, 73, and 87 are dependent from claims 3, 38, 56, or 86 and therefor are also included in the rejection.

With regard to claims 8, and 43, Cabib et al place the movable mirror in the reflection path of the beam-splitter while Tsuda places the movable mirror in the transmission path. Therefor, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cabib et al by placing the movable mirror in either path of the Michelson interferometer.

The motivation for this modification would have been based on the mount configuration and thus a mere matter of choice in design of art-recognized equivalents.

Claims 9, 10, 12, 13, 23, 24, 27-37, 44, 45, 47, 48, 61, 62, 64, 65, 88, 89, 91, and 92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cabib et al(5,539,517) and Tsuda(6,697,160) as applied to claims 3-8, 11, 21, 22, 38-43, 46, 56-60, 63, 73, 86, 87, and 90 above, and further in view of Erickson(5,440,388).

As to claims 9, 44, 61, and 88; Cabib et al fail to teach wherein the extent of said piezoelectrically changing said magnitude of said optical path difference of said divided collimated object emission beam along said axis is in a range of from about zero wavelengths to about ten wavelengths of said divided collimated object emission beam.

As to claims 10, 45, 62, and 89; Cabib et al fail to teach wherein the maximum of said magnitude of said optical path difference of said divided collimated object emission beam is on order of ten wavelengths of said divided collimated object emission beam.

As to claims 12, 47, 64, and 91; Cabib et al fail to teach wherein said piezoelectric motor controller operates by applying AC voltage or current to said distance change feedback sensor.

As to claims 13, 48, 65, and 92; Cabib et al fail to teach wherein said AC voltage is generated by a stable sinusoidal signal generator stabilized by an amplitude stabilizer.

As to claim 23, Cabib et al **fail to teach** the step of: (e) improving quality of said plurality of recorded interference images, for forming a plurality of improved quality interference images.

As to claim 24, Cabib et al **fail to teach** wherein step (e) includes the step of: filtering out noise from said plurality of recorded interference images, by passing said plurality of recorded interference images through a noise reduction filter.

As to claim 27, Cabib et al **fail to teach** wherein step (e) includes the step of: improving resolution of said plurality of recorded interference images, by using an image resolution improvement procedure.

As to claim 28, Cabib et al teach wherein a plurality of said generated interference images, each featuring a slightly different said magnitude of said optical path difference, is obtained by modulating said piezoelectric motor while performing step (d), said generated interference images for each said change in said magnitude of said optical path difference**(column 1, line 63- column 2, line 6)**. However, Cabib et al **fail to teach** recording a plurality of at least twenty, and up to about five-hundred images.

As to claim 29, further comprising the step of:

(f) transforming each of said plurality of improved quality interference images from time domain to frequency domain, for forming a corresponding plurality of interferogram images**(column 8, lines 61-63)**.

As to claim 30, Cabib et al **fail to teach** wherein said transforming is performed by using a Fast-Fourier-Transform procedure.

As to claim 31, wherein said plurality of interferogram images are used for synthesizing and analyzing three-dimensional hyper-spectral cube images(**column 1, line 63- column 2, line 6**).

As to claim 32, Cabib et al **fail to teach** the step of:

(g) improving quality of each of said plurality of interferogram images by mathematically increasing maximum of said magnitude of said optical path difference, for forming a plurality of improved quality interferogram images.

As to claim 33, Cabib et al **fail to teach** wherein step (g) said plurality of interferogram images is deconvolutioned using a sinc function, [sin(x)/x].

As to claim 34, Cabib et al **fail to teach** wherein step (g) said plurality of interferogram images is deconvolutioned using a $(\text{sinc})^2$ function.

As to claim 35, Cabib et al **fail to teach** the step of:

(h) correcting phase of pixels in each of said plurality of improved quality interferogram images, for forming a plurality of phase corrected improved quality interferogram images.

As to claim 36, Cabib et al **fail to teach** further comprising the step of:

(i) transforming each of said plurality of phase corrected improved quality interferogram images, from wave number units to uniformly dispersed wavelength units, for forming a synthesized hyper-spectral cube image.

As to claim 37, Cabib et al **fail to teach** the step of: analyzing a plurality of said synthesized hyper-spectral cube images, by applying a pattern recognition and classification type of image analysis algorithm.

Erickson teaches an imaging Fourier transform spectrometer(**Fig. 2**) including a piezoelectric motor(**Fig. 2, 13**) driven at 30Hz with an AC sinusoidal low voltage signal(**column 17, lines 25-31**). Erickson teaches a mirror scan of twenty or fewer wavelengths(**column 5, lines 36-40**). Sampling is based on the desired resolution 1/d, where d is the path length change, while the sampling interval is w/2, where w is the maximum wavenumber of interest(**column 5, lines 7-10**). Erickson specifically teaches providing 2000 sample images(**column 5, lines 40-44**). Signal processing is performed using a fast Fourier transform algorithm(**column 5, lines 45-55**). The detected images are digitally filtered to remove noise(**column 5, lines 56-60**), fast Fourier transformed(**column 5, lines 45-55**), filtered to pass the desired frequency range(**column 5, lines 60-60-68**), evaluated with a multivariate calibration regression method(**column 6, lines 3-4**), and then displayed using color to convey information(**column 5, lines 5-6**). Image enhancement algorithms may be used to maximize contrast and improve resolution(**column 12, lines 56-58**).

With regard to claims 9, 10, 44, 45, 61, 62, 88, and 89; Cabib et al are silent about the wavelength range scanned. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to set the optical

path difference to scan any number of wavelengths, Erickson teaches twenty wavelengths or fewer which would include the range of about ten wavelengths.

The motivation for this modification is found in Erickson that the range is set based on the specific analytical problem.

With regard to claims 12, 13, 47, 48, 64, 65, 91, and 92; Cabib et al uses a sinusoidal drive signal but is silent about specifics. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to drive the Cabib piezoelectric motor with an controlled AC signal at 30 Hz.

The motivation for this modification is found in Erickson which teaches driving the piezoelectric motor to provide small path differences at precise intervals.

With regard to claims 23, 24, and 27; Cabib et al only disclose a basic Fourier transform processing arrangement. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include image enhancement processing of the detected images including digital filtering and image enhancement algorithms.

The motivation for this modification is found in Erickson, which applies various image enhancement processes to improve the signal-to-noise ratio.

With regard to claims 28-31, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cabib et al by applying a fast Fourier transform as the appropriate matrix inversion and selecting the

number of samples, including a range of a plurality of at least twenty to about five-hundred images, dependent on the desired resolution and sampling interval.

The motivation for this modification is found in Erickson which teaches the speed advantages of the fast Fourier transform and the relationship between resolution, sampling interval, and the number of samples(images) generated.

Official notice is taken that amplitude adjustment, deconvolution, and phase correction are known processing algorithms in the spectrometer art. See In re Malcom, 1942 C.D 589; 543 O.G. 440.

If applicant does not traverse the examiner's assertion of official notice or applicant's traverse is not adequate, the next Office action will indicate that the common knowledge or well-known in the art statement is taken to be admitted prior art because applicant either failed to traverse the examiner's assertion of official notice or that the traverse was inadequate.

With regard to claims 32-37, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the various algorithms claimed, amplitude adjustment, claim 32; deconvolution, claims 33 and 34; phase correction, claims 35 and 36; or image analysis, claim 37 in order to enhance image quality or, as in the case of claim 37, analyze the hyper-spectral cube.

The motivation for this modification in Erickson which teaches applying image enhancement algorithms may be used to maximize contrast and improve resolution, and multivariate calibration regression methods to analyze the hyper-spectral cube.

Claims 14-17, 49-52, 66-69, and 93-96 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cabib et al(5,539,517) and Tsuda(6,697,160) as applied to claims 3-8, 11, 21, 22, 38-43, 46, 56-60, 63, 73, 86, 87, and 90 above, and further in view of Schwiesow(4,444,501).

As to claims 14, 49, 66, and 93; Cabib et al **fail to teach** wherein said distance change feedback sensor is in a form of a capacitor sensor, including a capacitor having two plates, and being configured such that a first plate of said capacitor is connected to said movable mirror, and a second plate of said capacitor is connected to said optical interferometer mount.

As to claims 15, 50, 67, and 94; Cabib et al **fail to teach** wherein distance of said movable mirror along said axis changes via actuation and operation of said piezoelectric motor, such that distance between said two plates of said capacitor changes, causing a change in capacity concurrent with a change in potential difference existing between said two capacitor plates.

As to claims 16, 51, 68, and 95; Cabib et al **fail to teach** wherein said potential difference existing between said two capacitor plates of said distance change feedback sensor is measured by said piezoelectric motor controller.

As to claims 17, 52, 69, and 96; Cabib et al **fail to teach** wherein said actuating and controlling said piezoelectric motor by said piezoelectric motor controller is performed according to said measurement of said potential difference, and according to a required change in said distance of said movable mirror along

said axis received by said piezoelectric motor controller in a form of a command sent by a signal processing unit operatively connected to said piezoelectric motor controller.

Schwiesow teaches sensing the path length change(spacing) of a piezoelectric translator using a capacitance micrometer having one plate on the mirror and one on a fixed point(column 1, lines 44-49).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cabib et al in view of Tsuda by replacing the laser reference with a capacitance micrometer to detect the path length change of the moveable mirror.

The motivation for this modification is based on a reduction in size from the capacitance displacement sensor, as well as a reduction in cost from eliminating the reference laser and detector.

Claims 18-20, 53-55, 70-72, and 97-99 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cabib et al(5,539,517), Tsuda(6,697,160) and Schwiesow(4,444,501) as applied to claims 3-8, 11, 14-17, 21, 22, 38-43, 46, 49-52, 56-60, 63, 66-69, 73, 86, 87, 90 and 93-96 above, and further in view of Seago et al(5,801,830).

As to claims 18, 53, 70, and 97; Cabib et al fail to teach further including a calibration procedure for calibrating changes in said magnitude of said optical path difference of said divided collimated object emission beam, and for calibrating said

magnitude of said optical path difference of said divided collimated object emission beam.

As to claims 19, 54, 71, and 98; Cabib et al **fail to teach** further including a calibration procedure for calibrating changes in said magnitude of said optical path difference of said divided collimated object emission beam, and for calibrating said magnitude of said optical path difference of said divided collimated object emission beam.

As to claims 20, 55, 72, and 99; Cabib et al **fail to teach** wherein said calibration procedure includes measuring and generating calibration values of a relationship between said potential difference existing between said two capacitor plates of said distance change feedback sensor and said optical path difference of said divided collimated object emission beam, for actuating a said change in said distance of said movable mirror along said axis.

Seago et al teach a scanning etalon type spectrometer in which the optical path change is measured with a capacitance sensor and a position stabilization circuit either maintains the etalon gap or adjusts the gap to selected portions of the measured spectrum(**column 5, line 60- column 6, line 14**). A calibration of the gap distance is determined by comparing a known signal with the same signal measured by the spectrometer(**column 10, lines 46-48**). A look-up table is generated and stored in the controller(**column 10, lines 48-50**). Calibration of the spectrometer

is necessary because of sensitivities to mechanical shock, vibration, and temperature variations.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to calibrate a spectrometer piezoelectric motor by creating a look-up table of known measured signals under different noise conditions.

The motivation for this modification would have been to accurately determine the correct path length change.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cabib et al(5,539,517), Tsuda(6,697,160), and Erickson(5,440,388) as applied to claims 3-13, 21-24, 27-48, 56-65, 73, and 86-92 above, and further in view of Inoue et al(5,253,183).

As to claim 25, Cabib et al fail to teach wherein step (e) includes the step of: correcting distortions of specific spatial frequencies of said recorded interference images, due to imperfections in construction and/or operation of said optical interferometer, by using a spatial frequency distortion correction look-up table.

Inoue et al teach an imaging spectrometer which includes correcting for disrortions in the optical system(column 6, lines 33-35).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to also correct for any optical system distortions when digitally filtering other noise signals, as found in Erickson.

The motivation for this modification would have been removal of another source of noise.

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cabib et al(5,539,517), Tsuda(6,697,160), and Erickson(5,440,388) as applied to claims 3-13, 21-24, 27-48, 56-65, 73, and 86-92 above, and further in view of Cabib et al(6,088,099).

As to claim 26, Cabib et al(5,539,517) **fail to teach** wherein step (e) includes the step of: correcting dynamic imaging errors associated with successively recording each said generated interference image, resulting from movements of line-of-sight during the hyper-spectral imaging, by applying a translation correction procedure to said plurality of recorded interference images.

Cabib et al(6,088,099) teach correcting the spatial and spectral information for movements of the moving object via a spatial registration and spectral correction procedures for obtaining corrected spatial and spectral information(**abstract**).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to include correcting the spatial and spectral information for movements of the moving object in the processing found in Erickson.

The motivation for this modification would have been removal of another source of noise.

Claims 74, 76-85, 100, and 102-111 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cabib et al(5,539,517) and Tsuda(6,697,160) as applied to

claims 3-8, 11, 21, 22, 38-43, 46, 56-60, 63, 73, 86, 87, and 90 above, and further in view of Bleier et al(5,949,543).

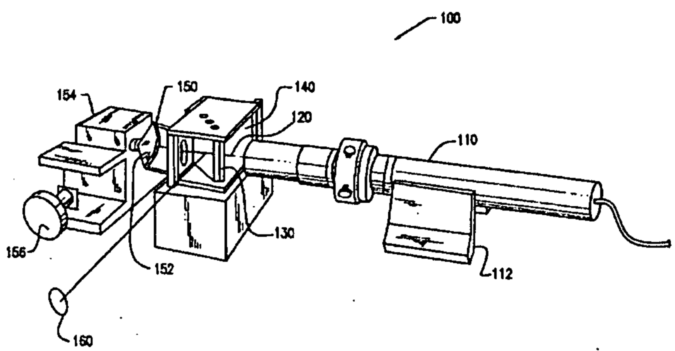


FIG. 2

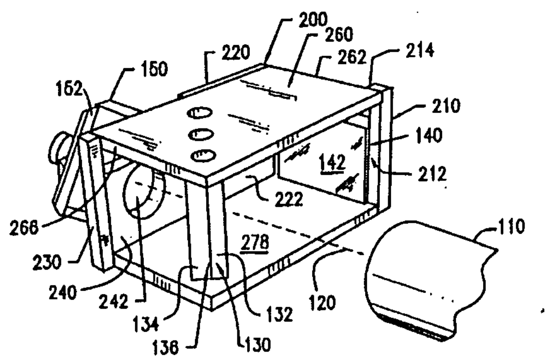


FIG. 3

As to claims 74 and 100, Cabib et al **fail to teach** wherein said optical interferometer mount includes: a fixed mount section, a movable mount section, a mounting location of said beam splitter on said fixed mount section, a mounting location of said fixed mirror on said fixed mount section, a mounting location of said movable mirror on said movable mount section, a mounting location of said piezoelectric motor inside of said fixed mount section, and a mounting location of said distance change feedback sensor on said fixed mount section.

As to claims 76 and 102, Cabib et al **fail to teach** wherein said optical interferometer mount is of a three dimensional curvilinear structure selected from the group consisting of a complex structure including a combination of at least two separate structures, and, an integral structure including a single structure or an integral combination of said at least two separate structures.

As to claims 77 and 103, Cabib et al **fail to teach** wherein said optical interferometer mount has a coefficient of thermal expansion of less than about $1.0x10^{-4}/^{0}K$, thereby exhibiting high rigidity, high dimensional stability, extremely low thermal expansion, and extremely low mechanical sensitivity to temperature changes, during the real time hyper-spectral imaging, for reducing dependency of said optical path difference of said divided collimated object emission beam, and changes thereof, on said temperature changes.

As to claims 78 and 104, Cabib et al **fail to teach** wherein said optical interferometer mount has a coefficient of thermal expansion of less than about $1.0x10^{-5}/^{0}K$, thereby exhibiting high rigidity, high dimensional stability, extremely low thermal expansion, and extremely low mechanical sensitivity to temperature changes, during the real time hyper-spectral imaging, for reducing dependency of said optical path difference of said divided collimated object emission beam, and changes thereof, on said temperature changes.

As to claims 79 and 105, Cabib et al **fail to teach** wherein said optical interferometer mount has a coefficient of thermal expansion of on order of about $1.0x10^{-6}/^{0}K$, thereby exhibiting high rigidity, high dimensional stability, extremely low thermal expansion, and extremely low mechanical sensitivity to temperature changes, during the real time hyper-spectral imaging, for reducing dependency of said optical path difference of said divided collimated object emission beam, and changes thereof, on said temperature changes.

As to claims 80 and 106, Cabib et al **fail to teach** wherein said optical interferometer mount is made of an alloy or mixed metallic type of material being a stainless steel alloy including at least one metal selected from the group consisting of nickel and cobalt, wherein said material has a coefficient of thermal expansion of less than about $1.0x10^{-4}/^0K$.

As to claims 81 and 107, Cabib et al **fail to teach** wherein said optical interferometer mount is made of an alloy or mixed metallic type of material being a stainless steel alloy selected from the group consisting of a stainless steel alloy including about 36% nickel, a stainless steel alloy including stainless steel and about 36% nickel, a stainless steel alloy including about 36% nickel and up to about 5% cobalt, and, a stainless steel alloy including steel, about 36% nickel, and up to about 5% cobalt, wherein said material has a coefficient of thermal expansion of less than about $1.0x10^{-5}/^0K$.

As to claims 82 and 108, Cabib et al **fail to teach** wherein said optical interferometer mount is made of an alloy or mixed metallic type of material being a steel alloy selected from the group consisting of an INVAR steel alloy, and an INVAR type of steel alloy, wherein said material has a coefficient of thermal expansion of on order of about $1.0x10^{-6}/^0K$.

As to claims 83 and 109, Cabib et al **fail to teach** wherein said optical interferometer mount is made of an alloy or mixed metallic type of material being a stainless steel alloy selected from the group consisting of an INVAR stainless steel

alloy, and an INVAR type of stainless steel alloy, wherein said material has a coefficient of thermal expansion of on order of about $1.0x10^{-6}/^{0}K$.

As to claims 84 and 110, Cabib et al **fail to teach** wherein said INVAR is high purity INVAR 36, including a carbon content of less than about 0.01%.

As to claims 85 and 111, Cabib et al **fail to teach** wherein said optical interferometer mount is made of a solid non-metallic type of material selected from the group consisting of quartzes, glasses, ceramics, and glass ceramics.

Bleier et al teach a monolithic Michelson spectrometer**(Fig's 2,3)** comprising a fixed mount section**(Fig. 3, 200)**, a movable mount section**(Fig. 2, 154)**, a mounting location of said beam splitter on said fixed mount section**(Fig's 2,3; 130)**, a mounting location of said fixed mirror on said fixed mount section**(Fig's 2,3; 140)**, a mounting location of said movable mirror on said movable mount section**(Fig's 2,3; 152)**, and a mounting location of said piezoelectric motor inside of said fixed mount section**(Fig's 2,3; 154)**, and a mounting location of said distance change feedback sensor on said fixed mount section**(column 5, lines 56-65)**. The mount is made of the same material, either quartz or annealed Pyrex, having a low coefficient of expansion**(column 5, lines 46-49)**.

With regard to claims 74, 76, 85, 100, 102, and 111; it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Cabib et al spectrometer by mounting the elements in the optical assembly of Bleier et al.

The motivation for this modification would have been to reduce the effects of temperature on the spectrometer.

With regard to claims 77-79, and 103-105; it would have been obvious to one of ordinary skill in the art at the time the invention was made to choose materials based on there low coefficients of expansion, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

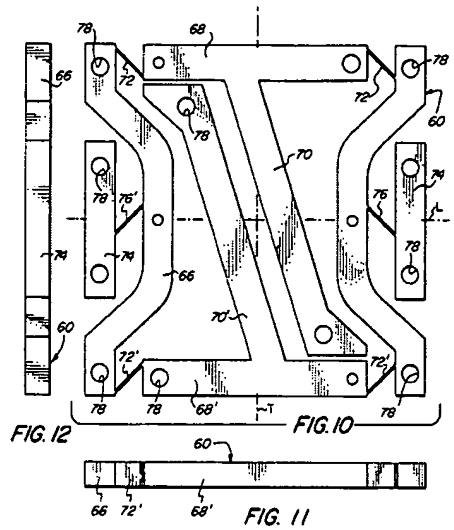
The motivation for this modification would have been to reduce temperature effects to there lowest possible level.

With regard to claims 80-84, and 106-110; Official notice is taken that various stainless steel alloys, including INVAR, are known low coefficient of expansion materials. See In re Malcom, 1942 C.D 589; 543 O.G. 440.

If applicant does not traverse the examiner's assertion of official notice or applicant's traverse is not adequate, the next Office action will indicate that the common knowledge or well-known in the art statement is taken to be admitted prior art because applicant either failed to traverse the examiner's assertion of official notice or that the traverse was inadequate.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use any material based on there low coefficients of expansion, since it has been held that discovering an optimum value or range of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980) and *In re Aller*, 105 USPQ 233.

Claims 75 and 101 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cabib et al(5,539,517), Tsuda(6,697,160), and Bleier et al(5,949,543) as applied to claims 3-8, 11, 21, 22, 38-43, 46, 56-60, 63, 73, 74, 76-87, 90, 100, and 102-111 above, and further in view of Carangelo et al(5,486,917).



As to claims 75 and 101, Cabib et al **fail to teach** wherein said optical interferometer mount further includes:

a plurality of spring or spring-like motion/direction stabilizing elements, operatively connected to said fixed mount section and operatively connected to said movable mount section, for stabilizing motion and/or direction of said movable mount section and of said movable mirror during the real time hyper-spectral imaging.

Carangelo et al teach plurality of springs(Fig. 10; 72,72') and stabilizing elements(Fig. 10; 68,68') connected to a fixed mount section(Fig. 10, 74) and a

movable mount section(**Fig. 10; 60,66**). This arrangement that the movement of the scanning mirror is co-linear with the optical axis (**column 5, lines 28-41**).

The motivation for this modification would have been to provide stabilization to the movable mirror.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Samuel A. Turner whose phone number is 571-272-2432.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr., can be reached on 571-272-2800 ext. 77.

The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Samuel A. Turner
Primary Examiner
Art Unit 2877